

nearby, examined the underground river that runs westwards from Green Lake and penetrated for some distance its cavernous course. From the Arrowsmith we turned eastwards to Three Springs, on the Midland railway, and then back to Perth. Drummond was very familiar with this country as his collections demonstrate.

Gardner was a good bushman and a tremendous walker and often taxed my ability to keep up with him. I found it easier to jog along than try and keep up at a walking gait, as he could maintain a walking rate in excess of four miles per hour in the bush and keep it up for hours. We enjoyed many collecting trips together over the years and our last one was only about twelve months before he died, when we did some collecting between Perenjori and Lake Moore. He was failing then and I realised that it would probably be our last journey together. He had an indomitable spirit and although under doctor's orders not to walk more than half a mile or climb hills, I had great difficulty in restraining him. He was always at his best when out in his beloved bush, a stimulating companion with a keen sense of humour and an encyclopaedic knowledge of our flora with which his name is indelibly linked. He certainly enriched my life by arousing my interest in it.

NOTES ON THE BIOLOGY OF *VARANUS TRISTIS*

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Varanus tristis, commonly called the "Mournful" or "Raeehorse" Goanna, is a medium-sized arboreal monitor lizard (Fig. 1). Although the species is widespread, occurring virtually throughout Australia, rather little has been reported about its biology. Two races are currently recognized, a nearly pure black form, *tristis*, and a paler and more colourful inland race, *orientalis* (described by Fry, 1913). It has been thought that *V. tristis tristis* is confined to south-western W.A., while *V. t. orientalis* ranges across



Fig. 1.—An adult male *Varanus tristis* from 24 miles east of Laverton, W.A. The head, forelegs, and distal parts of the tail are nearly pitch black. The dorsum and anterior parts of the tail are a speckled mixture of grey, beige, yellow and pink. When held, the lizards maintain a very stiff posture.

Queensland, the Northern Territory, northern Western Australia, and inland New South Wales (Mertens, 1958). This race probably extends well into north-western South Australia.

Zietz (1914) quotes field notes of Captain S. A. White on the species: "Met with on several occasions in the MacDonnell Ranges, and although at times found amongst rocks and boulders, it seems to have a liking for tree-climbing, for it was seen on more than one occasion basking at the top of a dead tree trunk in the beds of the creeks. Their food seems to consist of other small lizards, birds, and small mammals. On one occasion a specimen when pursued took to a large dead gum on the bank of Ellery Creek and scampered up to the very top, where it lay hidden behind a branch out of gunshot."

The present report is based primarily upon 23 specimens collected in the Wiluna, Lake Carnegie, Agnew, Laverton, and Great Victoria Desert districts of Western Australia, and now deposited in the Los Angeles County Museum of Natural History. As these specimens appear to be closer to the subspecies *tristis* than to *orientalis*, it may be that the race *tristis* is more widespread than formerly thought. Perhaps these subspecies grade into each other along the Northern Territory-Western Australian border.

In central Western Australia, *V. tristis* has a strongly seasonal annual pattern of activity, similar to that of *Varanus gouldi* (Pianka, 1970). Table 1 summarizes data showing that these lizards are usually active only from August to January. They are most conspicuous during September and October, which is probably the breeding season (below).

TABLE 1. DATA DEMONSTRATING PRONOUNCED SEASONALITY OF ACTIVITY IN *V. tristis*.

MONTH	NUMBER OF DAYS SPENT IN FIELD	NUMBER OF <i>tristis</i> COLLECTED	NUMBER PER DAY
JANUARY	26	2	.077
FEBRUARY	20	0	.00
MARCH	15	0	.00
APRIL	2	0	.00
MAY	17	0	.00
JUNE	14	0	.00
JULY	0	0	—
AUGUST	17	2	.118
SEPTEMBER	16	11	.687
OCTOBER	26	6	.231
NOVEMBER	30	2	.067
DECEMBER	24	0	.00
TOTALS	207	23	

Due to the fact that *V. tristis* drag the base of their tails when walking on the ground, their tracks on sand are highly distinctive and easily followed (Figure 2). The incidence of tracks closely reflects Table 1; no tracks were observed during the period from February through June, 1967. Most of the specimens collected were tracked down (many more were tracked long distances but never collected); a good deal of information

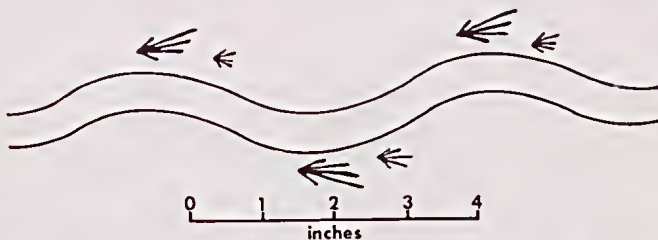


Fig. 2.—Diagrammatic representation of the track of *V. tristis*. The delicate front footprints frequently are not visible. Old tracks may not even show the prominent hind footprints.

concerning their activities can be deduced from these tracks. The lizards usually take a fairly direct route from tree to tree, apparently climbing many trees along the way. Daily forays frequently cover distances of nearly a mile. The animals are exceedingly wary, usually taking refuge in gum tree hollows before the tracker realizes that he is near the end of the trail. Most of my specimens were collected by waiting quietly below the tree with a .410 shotgun and/or .22 calibre rat-shot until the lizards appeared. They emerge from the shadows quickly, very cautiously and slowly, head first, and instantly freeze upon seeing a human. The nearly pitch black head, which looks much like a burnt snag, is easily overlooked.

V. tristis are fairly common well into the Great Victoria desert at Neale junction, and their tracks indicate that they occur throughout the desert almost wherever there are moderately large eucalypt trees.

In Table 2, the diet of 19 lizards with food in their stomachs is tabulated. Prey size ranges from 0.1 cc. (large ants) to about 25 cc. (a half-grown *Amphibolurus barbatus minor*). The mean prey size is quite large, 1.89 cc. One specimen contained a partially digested baby parrot, unidentifiable to species (identified as a parrot by its feet). It seems probable that nestling birds constitute an important item in the diet of *Varanus tristis*.

TABLE 2. STOMACH CONTENTS OF 23 *Varanus tristis*. VOLUMES MEASURED IN CUBIC CENTIMETRES. FOUR STOMACHS WERE EMPTY. FREQUENCIES BASED ON 19.

FOOD ITEM	NUMBER	VOLUME	FREQUENCY
ANTS	5	0.5	.053
GRASSHOPPERS	26	17.8	.421
ROACHES	1	2.9	.053
STICK INSECTS	1	1.0	.053
BETTERLES	1	3.0	.053
UNIDENTIFIED INSECTS	4	2.4	.210
BIRDS	1	5.7	.053
LIZARDS	4	56.3	.210
UNIDENTIFIED BONE?	1	0.8	.053
REPTILE EGGS	6	4.0	.105
TOTALS	<u>50</u>	<u>94.4</u>	

My wife and I were fortunate to observe a direct confrontation between a breeding galah cockatoo (*Cacatua roseicapilla*) and one of these lizards. On 22nd October, 1967, we were driving off the track slowly across the desert, about 10 miles north west of Agnew, W.A. at 4.30 in the afternoon. A galah was screeching loudly somewhere nearby, but not at us. Soon we saw the bird, with crest high and wings outstretched, screaming loudly as if in great distress. The galah, on the ground when first sighted, flew up on to a fallen log under a *Eucalyptus* tree and then into the tree (which later proved to be its nesting tree). As we approached, a large adult male (288 mm. snout-vent, 307 grams) *V. tristis* clambered over the same log towards the tree. While the galah continued to screech and began harassing the lizard, I approached the tree to try to collect the reptile. In an instant, the lizard was up the tree and out of sight around the other side. At this point the galah actually attacked the goanna (about 10 feet off the ground), and drove it back down and towards me, whereupon I shot the lizard. The incident suggests that these large climbing lizards are a potent threat to hole-nesting parrots.

The idea that baby birds, especially parrots, might constitute a major food of *V. tristis* correlates well with the lizard's seasonality of activity and foraging technique (above). During the spring when many birds are nesting, the lizards are very active, presumably building up fat reserves which get them through the next 6-8 months of relative inactivity. In this context, it is of interest that, after a prolonged drought in the Lorna Glen area when the nesting of parrots had doubtless been severely restricted, I collected two exceptionally emaciated *V. tristis* (fat bodies were large in all other *tristis* collected). In contrast, specimens of the terrestrial species *Varanus gouldi* and *V. eremius* collected during this period on the same area were fat and healthy.

Testes volumes do not vary appreciably in my sample of 17 males. Only one of the six females contained enlarged ovarian eggs. This female, collected on 29 September 1967, contained ten yolked follicles 8 mm in diameter, suggesting a large clutch size in this species.

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TRIAL EXCAVATION IN A SMALL CAVE, GINGIN

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INTRODUCTION

The small searp defining the summit of Poison Hill and neighbouring hills in the Gingin district includes numerous small recesses or caves in which one might expect various animals and perhaps Aborigines to shelter. After discussion with Dr. D. Merrilees (Western Australian Museum), I decided to excavate a small exploratory trench across the mouth of one of these small caves to look for signs of such occupation. To safeguard the deposit for future study, I adopted the precautions suggested by Merrilees (1968).

The site chosen was a small cave near the origin of the north branch of Wallering Brook, about 500 metres approximately south east from "Koorian" homestead, and just north of Poison Hill.

THE EXCAVATION

The cave had been used as a shelter by sheep which had left a thick layer of droppings. These were removed to a depth of about 5 cm over the area to be excavated, about 3 m long and $\frac{1}{2}$ m wide, through the entrance to the cave. Soil was removed from the trench by trowelling off thin layers, and was sieved through a small sieve of about 1 $\frac{1}{2}$ mm mesh. All bone, all stone suspected of being foreign to the site, and samples of plant and other organic debris remaining on the sieve and of soil were retained and are lodged in the Western Australian Museum (specimen Nos. 70.1.3 to 70.1.38, A 17554, A 17556), as are my field notes.

I recognized two divisions in the excavation, Layer 1 (the top 15 cm) and Layer 2, the lower part of the trench which reached bedrock at a depth of about 25 cm at the inner end of the trench and about 120 cm at the mouth of the cave. Thus the cave floor sloped up towards the back of the cave. Charcoal and various other plant remains, many of which would be identifiable, occurred throughout the deposit, and so did small pellets taken to be rat droppings. Layer 1 was richer in organic debris, especially bone, than Layer 2. A burrow had penetrated Layer 2.